10. Explanations may vary. For example:
Visualize a number line.

When we add a positive number, we move to the right. The sum of two positive rational numbers is always greater than the numbers added. For example: 2.45 + 3.27 = 5.72; 5.72 is greater than 2.45 and 3.27.

When we add a negative number, we move to the left. The sum of a positive rational number and a negative rational number is less than the positive number, but greater than the negative number. For example: 9.03 + (–24.56) = –15.53; –15.53 is less than 9.03, but greater than –24.56.

The sum of two negative rational numbers is always less than both numbers.
For example: (–1.5) + (–3.6) = –5.1. –5.1 is less than both –1.5 and –3.6.

11. Strategies may vary.

a)
$$-\frac{2}{3}+\frac{1}{2}=-\frac{4}{6}+\frac{3}{6}$$
$$=-\frac{1}{6}$$

b)
$$\frac{4}{5}+\left(-\frac{1}{3}\right)=\frac{12}{15}+\left(-\frac{5}{15}\right)$$
$$=\frac{12-5}{15}$$
$$=\frac{7}{15}$$

c)
$$-\frac{11}{4}+\left(-\frac{6}{5}\right)=-\frac{55}{20}+\left(-\frac{24}{20}\right)$$
$$=\frac{-55-24}{20}$$
$$=-\frac{79}{20}\text{, or }-3\frac{19}{20}$$

d)
$$\frac{13}{5}+\frac{9}{2}=\frac{26}{10}+\frac{45}{10}$$
$$=\frac{26+45}{10}$$
$$=\frac{71}{10}\text{, or }7\frac{1}{10}$$

e) $-2\frac{1}{3}+\left(-1\frac{3}{4}\right)$

Add the whole numbers and add the fractions.
$$-2\frac{1}{3}+\left(-1\frac{3}{4}\right)=(-2)+\left(-\frac{1}{3}\right)+(-1)+\left(-\frac{3}{4}\right)$$
$$=\left[-2-1\right]+\left[-\frac{1}{3}+\left(-\frac{3}{4}\right)\right]$$
$$=(-3)+\left[-\frac{4}{12}+\left(-\frac{9}{12}\right)\right]$$
$$=(-3)+\left[\frac{-4-9}{12}\right]$$
$$=(-3)+\left[\frac{-13}{12}\right]$$
$$=(-3)+\left[-1\frac{1}{12}\right]$$
$$=-4\frac{1}{12}$$

f) $\frac{9}{5}+\left(-\frac{17}{6}\right)$

Use equivalent fractions with denominator 30.
$$\frac{9}{5}+\left(-\frac{17}{6}\right)=\frac{54}{30}+\left(-\frac{85}{30}\right)$$
$$=\frac{54-85}{30}$$
$$=\frac{-31}{30}\text{, or }-1\frac{1}{30}$$

g) $-3\frac{3}{4}+4\frac{5}{8}$

Add the whole numbers and add the fractions.
$$-3\frac{3}{4}+4\frac{5}{8}=(-3)+\left(-\frac{3}{4}\right)+4+\frac{5}{8}$$
$$=\left[-3+4\right]+\left[-\frac{3}{4}+\frac{5}{8}\right]$$
$$=1+\left[-\frac{6}{8}+\frac{5}{8}\right]$$
$$=1+\left(-\frac{1}{8}\right)$$
$$=\frac{8}{8}-\frac{1}{8}$$
$$=\frac{8-1}{8}$$
$$=\frac{7}{8}$$

h) $1\frac{5}{6}+\left(-5\frac{2}{3}\right)$

Add the whole numbers and add the fractions.

$$\begin{aligned}1\frac{5}{6}+\left(-5\frac{2}{3}\right)&=1+\frac{5}{6}+(-5)+\left(-\frac{2}{3}\right)\\&=[1-5]+\left[\frac{5}{6}+\left(-\frac{2}{3}\right)\right]\\&=(-4)+\left[\frac{5}{6}+\left(-\frac{4}{6}\right)\right]\\&=(-4)+\left[\frac{1}{6}\right]\\&=-\frac{24}{6}+\frac{1}{6}\\&=\frac{-24+1}{6}\\&=-\frac{23}{6}\text{, or }-3\frac{5}{6}\end{aligned}$$

i) $-3\frac{1}{4}+\left(-2\frac{1}{6}\right)$

Add the whole numbers and add the fractions.

$$\begin{aligned}-3\frac{1}{4}+\left(-2\frac{1}{6}\right)&=(-3)+\left(-\frac{1}{4}\right)+(-2)+\left(-\frac{1}{6}\right)\\&=(-5)+\left[\left(-\frac{1}{4}\right)+\left(-\frac{1}{6}\right)\right]\\&=(-5)+\left[\left(-\frac{3}{12}\right)+\left(-\frac{2}{12}\right)\right]\\&=(-5)+\left(-\frac{5}{12}\right)\\&=-5\frac{5}{12}\end{aligned}$$

j) $2\frac{3}{5}+\left(-1\frac{7}{8}\right)$

Add the whole numbers and add the fractions.

$$\begin{aligned}2\frac{3}{5}+\left(-1\frac{7}{8}\right)&=2+\frac{3}{5}+(-1)+\left(-\frac{7}{8}\right)\\&=1+\left[\frac{3}{5}+\left(-\frac{7}{8}\right)\right]\\&=1+\left[\frac{24}{40}+\left(-\frac{35}{40}\right)\right]\\&=1+\left(-\frac{11}{40}\right)\\&=\frac{40}{40}+\left(-\frac{11}{40}\right)\\&=\frac{29}{40}\end{aligned}$$

12. Explanations may vary. For example:
Visualize a number line.

a) When we add a positive number, we move to the right.
The sum of two positive rational numbers is always greater than the numbers added.
For example: 1.5 + 3.6 = 5.1; 5.1 > 0. So, the sum of two positive rational numbers is positive.

b) When we add a negative number, we move to the left.
The sum of two negative rational numbers is always negative and less than both numbers.
For example: (–1.5) + (–3.6) = –5.1; –5.1 < 0.
So, the sum of two negative rational numbers is negative.

c) For example: –1.5 + 3.6 = 2.1; 2.1 > 0
When the positive number is farther from 0 than the negative rational number is, the sum is positive.

For example: 1.5 + (–3.6) = –2.1; –2.1 <0
When the negative number is farther from 0 than the positive rational number is, the sum is negative.

When the rational numbers are opposites, their sum is 0.
For example: (–5.3) + 5.3 = 0

15. a) Use a rational number to represent each temperature: –13.4; 5.7
To determine the temperature at noon, add: –13.4 + 5.7 = –7.7, or –7.7°C

b) To determine the lowest temperature on Wednesday, add: –13.4 + (–3.7) = –17.1, or –17.1°C

c) Sketch a vertical number line labelled from 0 to –20. Mark both changes in temperature:
from –13.4 to –7.7 and from –13.4 to –17.1

17. a) Earnings can be represented with positive numbers, and expenses can be represented with negative numbers. Since Keith earned \$45.50 and \$22.25, these can be represented as 45.50 and 22.25. Since Keith spent \$15.77 and \$33.10, these can be represented as –15.77 and –33.10.

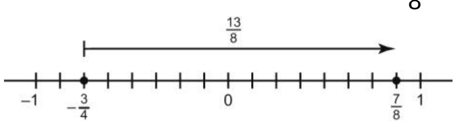
b) At the end of January, Keith's balance in dollars is: 45.50 + 22.25 + (–15.77) + (–33.10)

c) Keith's balance in dollars is: 45.50 + 22.25 + (–15.77) + (–33.10) = 18.88
Keith's balance is \$18.88.

18. Income can be represented with positive numbers, and expenses can be represented with negative numbers.
$2115.70+2570.40+(-545.50)+(-978.44)+(-888.00)+(-2540.20)=-266.04$

Since Lucille's balance is negative, she lost \$266.04. Lucille's business did not make a profit

20. a) Use a number line. Mark $-\frac{3}{4}$ and $\frac{7}{8}$ on the number line. To get from $-\frac{3}{4}$ to $\frac{7}{8}$, move 13 eighths to the right. So, the number is $\frac{13}{8}=1\frac{5}{8}$.



b) Investigate: If I have to add $\frac{4}{5}$ to a number to get $-\frac{2}{3}$, the number I'm looking for must be $\frac{4}{5}$ less than $-\frac{2}{3}$. So, $-\frac{2}{3}+\left(-\frac{4}{5}\right)=-\frac{22}{15}$ and $-\frac{22}{15}+\frac{4}{5}=-\frac{2}{3}$

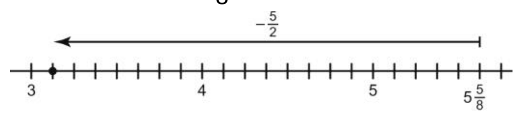
So, the number is $-\frac{22}{15}$, or $-1\frac{7}{15}$.

c) Use a number line. Mark $3\frac{1}{8}$ on the number line.
Investigate: Where do I start so that when I add $-\frac{5}{2}$ (move 5 halves to the left), I get $3\frac{1}{8}$?

I must start at a point that is $\frac{5}{2}$ to the right of $3\frac{1}{8}$; that is, $3\frac{1}{8}+\frac{5}{2}$

$$=3\frac{1}{8}+2\frac{1}{2}$$
$$=5\frac{5}{8}$$

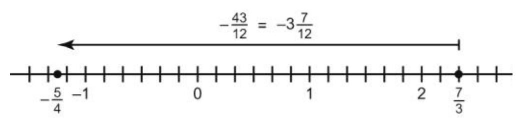
So, the number is $5\frac{5}{8}$.



d) Use a number line. Mark $\frac{7}{3}$ and $-\frac{5}{4}$ on the number line.
Investigate: What do I add to $\frac{7}{3}$ to get $-\frac{5}{4}$?

To get from $\frac{7}{3}$ to $-\frac{5}{4}$, move 43 twelfths to the left.

So, the number is $-\frac{43}{12}$ $-\frac{43}{12}$, or $-3\frac{7}{12}$.



21. $7.9+\square\leq 11.2$
Investigate: What do I add to 7.9 to get less than or equal to 11.2?
Write and solve the corresponding addition equation: $7.9+\square=11.2$
Since $7.9+3.3=11.2$, any number less than or equal to 3.3 will make the expression true.

22. Strategies may vary. For example:
Use what you know about adding rational numbers.
The possible negative fractions using –1, –2, –3, –4, 1, 2, 3, 4 are:

$\frac{-1}{1}, \frac{-1}{2}, \frac{-1}{3}, \frac{-1}{4}$ or $\frac{1}{-1}, \frac{1}{-2}, \frac{1}{-3}, \frac{1}{-4}$

$\frac{-2}{1}, \frac{-2}{2}, \frac{-2}{3}, \frac{-2}{4}$ or $\frac{2}{-1}, \frac{2}{-2}, \frac{2}{-3}, \frac{2}{-4}$

$\frac{-3}{1}, \frac{-3}{2}, \frac{-3}{3}, \frac{-3}{4}$ or $\frac{3}{-1}, \frac{3}{-2}, \frac{3}{-3}, \frac{3}{-4}$

$\frac{-4}{1}, \frac{-4}{2}, \frac{-4}{3}, \frac{-4}{4}$ or $\frac{4}{-1}, \frac{4}{-2}, \frac{4}{-3}, \frac{4}{-4}$

The possible positive fractions using –1, –2, –3, –4, 1, 2, 3, 4 are:

$\frac{-1}{-2}, \frac{-1}{-3}, \frac{-1}{-4}$ or $\frac{1}{2}, \frac{1}{3}, \frac{1}{4}$

$\frac{-2}{-1}, \frac{-2}{-3}, \frac{-2}{-4}$ or $\frac{2}{1}, \frac{2}{3}, \frac{2}{4}$

$\frac{-3}{-1}, \frac{-3}{-2}, \frac{-3}{-4}$ or $\frac{3}{1}, \frac{3}{2}, \frac{3}{4}$

$\frac{-4}{-1}, \frac{-4}{-2}, \frac{-4}{-3}$ or $\frac{4}{1}, \frac{4}{2}, \frac{4}{3}, \frac{4}{4}$

Since the denominators are 1, 2, 3, or 4, the rational number closer to 0 will have a denominator of 12. Then, the greatest possible sum less than 0 is $-\frac{1}{12}$. Use guess and test to determine the fractions. Possible addition statements are:

$\frac{2}{3}+\left(-\frac{3}{4}\right)=-\frac{1}{12}$ and $\left(-\frac{1}{3}\right)+\frac{1}{4}=-\frac{1}{12}$